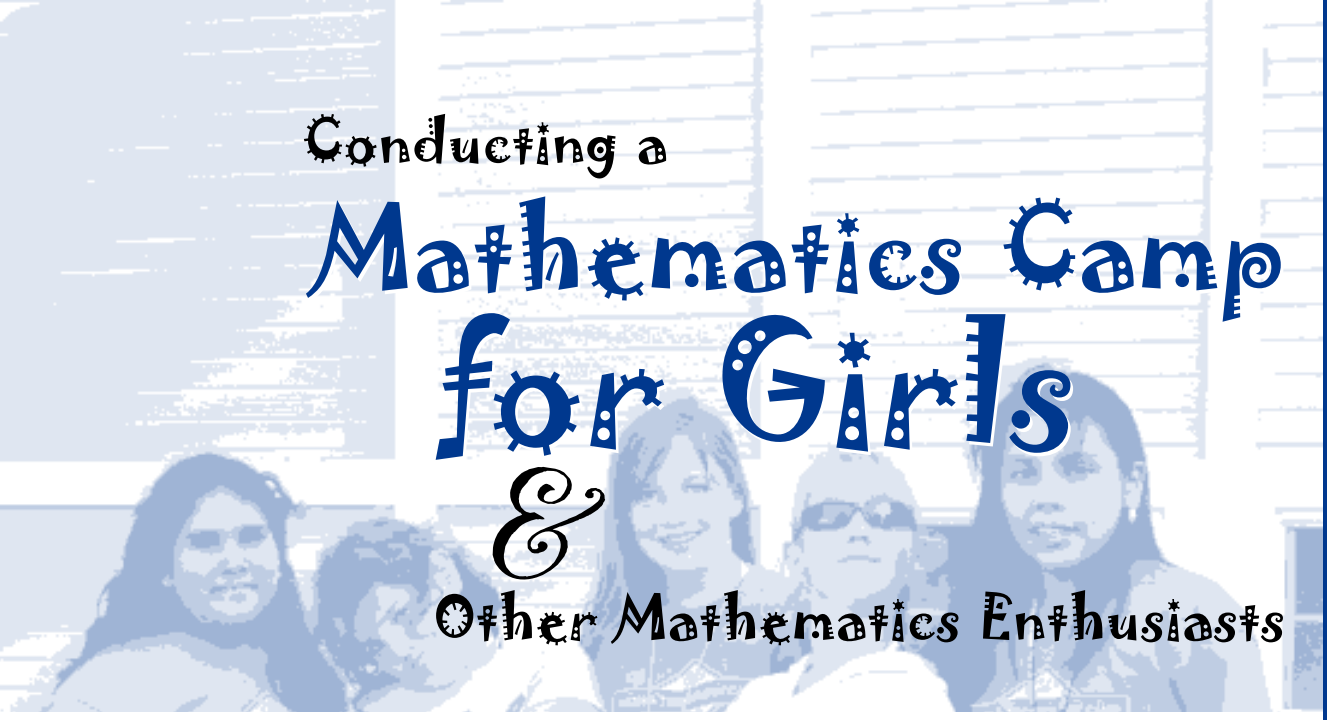

Conducting a Mathematics Camp for Girls & Other Mathematics Enthusiasts

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Throughout much of the world, boys continue to outscore girls on standardised mathematics tests. For example, in most of the 57 countries that participated in the Programme for International Student Assessment (PISA) 2006, boys' performance was significantly higher than girls on the mathematics scale (see www.pisa.oecd.org). This fact alone can harm girls' opportunities for competitive scholarships and entry into top colleges, attitudes toward the subject matter and themselves, and participation in mathematics-oriented occupations (e.g., Coombes, 2003).

Intervention programs are equitable measures for addressing the needs of special populations. They can have successful results in bolstering the knowledge, dispositions, and participation of underrepresented groups in domains in which they are marginalised (e.g., Mawasha, Lam, Vesalo, Leitch & Rice, 2001; Wiest, 2004). In its Equity Principle, the National Council of Teachers of Mathematics (NCTM, 2000) states that "some students may need further assistance to meet high mathematics expectations" and "may need additional resources, such as after-school programs" (p. 13).

In this article I describe a mathematics and technology intervention program for middle-grades girls. This description of the Northern Nevada Girls' Math and Technology Camp in the United States provides ideas for conducting other effective out-of-school programs.

The Girls' Math and Technology Camp

The Girls' Math and Technology Camp is a one-week, residential summer camp that has been held at the University of Nevada, Reno since 1998. Northern Nevada middle school girls (entering Grade 7 or 8) of varied abilities and backgrounds participate in the program. Topics include algebra (older girls), data analysis and probability (younger girls), geometry, computer skills (mathematics tool technology), problem solving, spatial reasoning, and biographical information about women in mathematics and/or computer science. Participants stay in campus residence halls, eat

in the campus cafeteria, and engage in various structured spare-time and recreational activities across the week, which begins Sunday evening and ends Friday afternoon. A full-day Saturday session is held in early November and another in early March as follow-up to the summer camp activities. A sample day's schedule for the summer camp appears in Figure 1.

Sample Thursday schedule for girls entering Grade 7

8:45 am	Problem solving/reasoning
9:15 am	Guest speaker on use of math/technology in the workplace
10:00 am	Data analysis and probability
10:30 am	Snack break
10:45 am	Data analysis and probability (continued)
11:45 am	Spatial-reasoning task
12:00 pm	Lunch
1:00 pm	Using geometry software (Terrapin Logo)
2:30 pm	Snack break
2:45 pm	Geometry
4:15 pm	Spare time
5:30 pm	Dinner
6:30 pm	Spare time
8:00 pm	Camper talent show

Note: Printed schedules for program participants include instructor/speaker names for each segment, room locations, and options available for spare-time segments.

Figure 1

Initial planning and preparation

The first task in planning an intervention program is to establish a target population. Likely program participants are a specialised group of students who need "something extra" in order to achieve parity with higher-achieving others. In this case, girls have been selected for their lower status in mathematics. The middle school level was chosen because it is a critical juncture for girls in mathematics, a point at which potential issues (e.g., weaker aspirations and attitudes) and practical decisions (e.g., course and career-track choices) particularly arise.

The next phase in planning an intervention program is establishing program goals and objectives. The main purpose of the Girls' Math and Technology Camp is to improve girls' knowledge, skills, dispositions, and participation in mathematics and mathematics-related technology use. Specific objectives (e.g., "to gain biographical information about contemporary and/or historical women in mathematics", or "to network academically and socially with peers and female mentors who share an interest in mathematics") were written to meet established goals. Appropriate content and experiences were then planned to help participants meet the program objectives.

Finally, planning an intervention program requires careful attention to logistical matters. A "catchy" program name might be chosen versus the purely descriptive one used for this program. Instructional facilities, equipment and materials, staff, recreational activities, and meals and housing need to be arranged. Instructional topics and accompanying standards/objectives must be established. Decisions about recruitment and selection procedures, including the number and type of program participants to be accepted, as well as about evaluation measures, need to be made. Relevant letters and forms must be created and program publicity considered. Items might be purchased for program participants and their parents. The Girls' Math and Technology Camp, for example, gives each participant a camp T-shirt and a spatial-reasoning souvenir (tangrams for the younger group, puzzle cubes for the older group). Some program components might be planned to rotate between two alternatives on a two-year basis so that return participants do not experience the same thing two years in a row. For this program, these include the guest speaker arranged, specific content of the segment on biographical information about women in mathematics/computer science, and sometimes selected recreational activ-

ities (although some are "perennial" favourites that bear repeating). Key program features, such as those described below, should be established for an intervention program to serve as the baseline structure for planning remaining details.

Key features of the Girls' Math and Technology Camp

The following main features guide operation of the Girls' Math and Technology Camp. They represent carefully considered values that form the backbone of the program. The "luxury" of the many strong components described here may have to be tempered with the practical realities of many other programmatic efforts.

Heterogeneous participant pool

Programs may choose to target specific types of students by gender, academic ability, or other personal background characteristics. For this program the delimiting factors include gender (girls) and region (Northern Nevada). The position taken is that all girls who express interest in mathematics and technology are welcome to attend. Applications are sent to all Northern Nevada public, private, charter, and Native American schools containing sixth or seventh grades. Submitted applications are numbered, and a random-number generator on a calculator is used to randomly select 30 girls for each of the two grade-level groupings. The result is a diverse participant group by academic ability, race/ethnicity, socioeconomic status, community type, and other background characteristics.

Access to good resources

Optimal program operation requires financial and human resources, as well as good facilities, equipment, and instructional tools and materials. Funding sources for the Girls' Math and Technology Camp are solicited annually to offset participant costs in order to encourage more girls to attend. Sufficient funding is acquired to reduce the registration fee to approximately half of the actual per-girl cost, and girls who provide evidence of free or reduced-cost lunch status attend for a nominal fee. University-provided graduate student services and designated office space offer important program support. Likewise, use of university classroom space, a computer lab, the campus cafeteria, residence halls, and recreational facilities (with relevant associated costs) are important program aspects. Quality equipment (e.g., computers and classroom document cameras) and instructional resources (e.g., manipulative materials and calculators) are further resources that support program success.

Substantial, significant mathematics and technology

Program participants engage with substantial, significant content based on the state mathematics standards for the grade the girls will enter the following fall. The girls thus have a "jump" on the next year's content, which contributes to the increased confidence and other positive program results they report at that point in time. Mathematics topics are those deemed to be important in the mathematics curriculum and in everyday life, as well as areas of mathematics to which the girls may have received little exposure and/or are known to perform more poorly than boys. Geometry and algebra, for example, are increasingly considered to be gatekeepers to higher mathematics that shape future career options, and females tend to need greater development of technological and spatial skills. The mathematics is thus "standard" but selectively chosen content that is taught effectively (as described below). (Other programs might choose another focus to fit their purpose, such as an enrichment, remedial, or project-based orientation.)

The program's instructional components incorporate participant use of tool technology, which involves more powerful technologies that support concept learning through high-level application of skills and reasoning. Specifically, this program includes use of geometry-related programming software, Terrapin Logo (2000), for the younger girls and the dynamic geometry software Geometer's Sketchpad (2001) for the older girls. The geometry teachers for the two camper groups coordinate their lessons with the computer instructor. Graphing calculators are also incorporated into the main instructional segments for one or both camper groups.

High-quality staff

One of the strongest aspects of this program is the high-quality staff. A separate instructor is hired for each of the five major instructional segments: geometry for each camper group, algebra (older girls), data analysis and probability (younger girls), and computer segments (same instructor for both groups). This approach facilitates securing high-demand instructors who might be able to spare the time to teach a single program segment, and it allows instructors to be matched to their area of expertise and to focus their preparation on one topic. Highly reputable local instructors are identified by soliciting recommendations from the university mathematics methods instructors, school district math coordinators, Northern Nevada Math Council President, and state and/or regional mathematics education personnel. Staff sought are women who teach upper elementary, middle, or lower high school and have approximately five or more years of teaching experience. They should have a master's degree, remain active in the field of mathematics education, use instructional methods promoted by the NCTM's (2000) *Principles and Standards for School Mathematics*, and have a personality well suited to working with middle school girls. Individuals recommended most often are those first invited to serve as camp instructors. University mathematics educators or doctoral students in mathematics education sometimes also serve as staff.

Four highly recommended upper-division elementary or secondary teacher education majors or beginning teachers, two per camper group, are hired to serve as instructional assistants. They assist instructors with lessons, conduct the problem-solving and spatial-reasoning segments, and supervise and lead the girls through all other day, evening, and overnight

camp components. The instructor to participant ratio is thus 1 to 10 (one instructor plus two instructional assistants for 30 girls) during all major instructional segments.

Effective teaching methods

Program instructors use research-based methods considered to be effective for most students and particularly so for females. Instruction tends to be hands-on, investigative, and applied. Students work in heterogeneous small groups that reconfigure daily, and they engage in conceptual learning that involves a good deal of reasoning and communication. The learning climate is comfortable, participatory, and supportive.

Residential aspect

The overnight aspect of the summer camp is a vital part of the program. It allows recreational and social time that creates bonding among staff and participants in a nonacademic outlet and fosters social skills and independence. Particularly important is the fact that a broader range of girls can participate in the program than might be the case for a day camp that enrols only local girls. (This is especially so for Nevada's large and under-served rural population.)

Recreational/social activities

Program participants have an opportunity to socialise during snacks and meals, spare-time segments, recreational activities, and evening residence hall time before the mandatory "lights-out." During spare-time options they may choose from several supervised options (e.g., computer lab time or outdoor recreation). Supervised recreation consists of structured activities attended by all girls. Recreation for the four weekday evenings includes a night at the campus gym or roller-skating rink (varies each year), a movie night (featuring a film with one or more strong female characters), a miniature golf and go-karts outing, and a talent show. The only recreation involving transportation is a half-day, mid-week bus trip to a local water park.

Role models and networking

The all-female staff and female guest speaker provide important role models to the girls. So, too, does the biographical information about women in mathematics and/or computer science presented during one instructional segment, which includes distributing packets of information about these women. Networking with similar-minded girls interested in mathematics and technology lends further support and connection.

Meals and snacks

Frequent provision of food enhances this program. The girls reported a great deal of satisfaction with this program aspect, which includes meals at the campus cafeteria and daily mid-morning and mid-afternoon snack breaks.

Parent involvement

Parent/guardian participation and "buy-in" are important to enlist. This program opens with an address to parents in which the Program Director shares information about girls and mathematics, the program philosophy and goals, and practical matters for the camp week. An informal reception follows. At the end of the week, parents join their daughters for demonstration of key concepts learned during the week, collaborative problem solving, and a final reception. For two years instructional sessions were held for parents on the first and last camp days on mathematics concepts and computer use similar to what the girls experience. (Although this was a good idea in theory, the sessions were recently discontinued due to insufficient resources to arrange and conduct them.) Finally, parents are supplied with handouts that give such information as perspectives about taking higher mathematics classes, mathematics needed for future careers, and resources for seeking information and supporting/encouraging girls in mathematics and technology.

Good organisation, structure, and supervision

A well-organised program with built-in structure and continual supervision of participants is a vitally important program aspect for achieving smoother operations and satisfying potential parent concerns. Parents identified this as one of the program features they found most important.

Continued support

To date this program has included a full-day Saturday session in the fall and another in the spring as follow-up activity to sustain knowledge and attitude gains made during the summer camp. Future plans are to replace the follow-up sessions with a web site that will provide year-round support and resources for program participants. (Web access for all girls might be an issue to address.)

Program evaluation and revision

Planning and implementing effective program evaluation measures yields important feedback that can be used to improve future operations. The Girls' Math and Technology Camp administers entrance, exit, and fall follow-up surveys that assess selected attitudes, background knowledge and

experience, and opinions about the program and its impact. The girls complete these three survey administrations, and the parents complete one in the fall. Interviews have also been conducted during spare-time segments of several summer camps (see, for example, Wiest 2004).

Program promotion

It is important to publicise the program and foster buy-in with school personnel, the public, potential funding sources, and key others to help build and maintain a strong and sustainable intervention program. Program purpose, operation, and results should be shared with relevant others to promote both moral and financial support. Funding, volunteer assistance, access to resources, moral support for continuation, and so forth can stem from these efforts. Such means for the Girls' Math and Technology Camp, besides the noted efforts to involve parents, include soliciting local media coverage, inviting key individuals from local organisations (e.g., potential funding sources) to visit the program during its operation, and giving talks about the program to local entities interested in education. Key university, school, and state education personnel are invited to visit the program while in session, including parent segments where they might be introduced publicly and mingle with parents and participants during scheduled receptions. Parents and campers are asked to consider writing letters of support for the program, if they are so inclined, that might strengthen requests for financial support. Other means of publicising and disseminating information about the program include developing a program web site, publishing articles, and conducting conference presentations.

Program outcomes and selected struggles

This program has produced highly successful results (e.g., Wiest 2004). Participants have shown statistically significant improvements in attitude. They (and their parents on their behalf) report greater knowledge and skills, improved grades, increased involvement in program topics, and greater social skills and independence, among other positive outcomes, from their participation in this program.

Several difficulties persist in conducting this program, three of which will be mentioned here. First is the ongoing effort to find funding and resources. To date university resources combined with funding provided by various sources, mostly local foundations, and participant registration fees have allowed this program to continue for ten years, but not without continued effort and annual uncertainty. (Note, however, that some programs may operate at cost, based on registration fees and would thus not need external funding.) Second, the greater-than-usual ability range of the girls, who come from a wide variety of backgrounds across a large geographic region, poses particular challenge for instructors to craft lessons that are rich enough to meet these diverse needs. Third, as might be expected with middle school girls, many of whom are away from home for the first time and/or do not know any other participants, issues of personal adjustment (e.g., homesickness) and interpersonal conflict are inevitable. Program successes, however, strongly outweigh these challenges.

Closing thoughts

This program is fortunate to have many high-quality features that may not be possible for others. Nevertheless, modifications — such as conducting a day rather than overnight camp — can still yield effective programs that serve important purposes.

Note

Readers may contact the author/Program Director, Dr Lynda R. Wiest, at wiest@unr.edu for copies of program documents, such as letters and forms, goals and objectives, evaluation instruments, and a summer camp packing list, as well as information about the forthcoming website and research manuscripts currently in preparation.

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References

Coombes, A.(15 September 2003). Gender Gap: College Test Bias Continues Unabated. *CBS MarketWatch.com*. Retrieved 4 October 2004 from http://www.womenswallstreet.com/WWS/Article_Print_Preview.aspx?strArticleID=512.

Key Curriculum Press (2001). *The Geometer's Sketchpad* [computer software]. Emeryville, CA.

Mawasha, P. R., Lam, P. C., Vesalo, J. Leitch, R. & Rice, S. (2001). Girls Entering Technology, Science, Math and Research Training (GET SMART): A Model for Preparing Girls in Science and Engineering Disciplines. *Journal of Women and Minorities in Science and Engineering 7*, 49–57.

National Council of Teachers of Mathematics [NCTM] (2000). *Principles and Standards for School Mathematics*. Reston, Va.: NCTM.

Terrapin Software (2000). *Terrapin Logo* [computer software]. Cambridge, MA.

Wiest, L. R. (2004). Impact of a Summer Mathematics and Technology Program for Middle School Girls. *Journal of Women and Minorities in Science and Engineering, 10*, 317–339.